CLAIMS

What is claimed is:

1. An ultra-high density data storage device using phase-change diode memory cells, and having a plurality of emitters for directing beams of directed energy, a layer for forming multiple data storage cells and a layered diode structure for detecting a memory or data state of the storage cells, the device comprising:

a phase-change data storage layer capable of changing states in response to the beams from the emitters; and

a second layer forming one layer in the layered diode structure, the second layer comprising a material containing copper, indium and selenium.

2. The storage device according to Claim 1, wherein the material comprising the second layer is a CuInSe material doped with galium.

3. The storage device according to Claim 1, wherein the phase-change data storage layer and the second layer form the layered diode structure.

4. The storage device according to Claim 1, wherein the phase-change layer comprises an indium selenide material.

5. The storage device according to Claim 4, wherein the phase-change layer comprises an In_xSe_{1-x} compound.

6. The storage device according to Claim 1, wherein the second layer is doped with a p-type dopant.

7. The storage device according to Claim 1, further comprising a field layer for forming a diode junction with the data storage layer to detect the flow of carriers across the diode junction.

8. The storage device according to Claim 7, wherein the field layer comprises molybdenum.

9. The storage device according to Claim 1, further comprising a silicon substrate adjacent to the second layer.

10. The storage device according to Claim 1, wherein the diode structure is a detection element in one of a group of data storage detection devices, selected from the group consisting of photovoltaic devices, cathodovoltaic devices, photoluminescent devices and cathodoluminescent devices.

11. A data storage array of multiple thin film layers adapted to form a plurality of data storage cell diodes comprising:

a silicon substrate;

a first diode layer having a CuInSe material fabricated over the silicon substrate; and

a second diode layer of phase-change material, fabricated on the first diode layer to form a diode junction with the second diode layer.

12. The data storage array according to claim 11, wherein the first diode layer is p-doped.

13. The data storage array according to claim 11 wherein the first diode layer comprises a $CuInSe_2$ material.

14. The data storage array according to claim 11 wherein the first diode layer comprises a CuInSe material doped with gallium.

15. The data storage array of claim 11, wherein the second diode layer is phase changeable between first and second states, in response to an electron or light beam.

16. The data storage array according to claim 15, wherein the second diode layer is an indium selenide material.

17. The data storage array according to claim 16, wherein the second diode layer is an In_xSe_{1-x} material.

18. The data storage array according to claim 11, wherein the substrate is soda lime glass.

19. The data storage array according to claim 11, further comprising a field layer fabricated on the substrate.

20. The data storage array according to claim 19, wherein the field layer is composed of molybdenum.

21. The data storage array according to claim 11, further comprising a voltage connection points on opposite sides of the diode junction to impress a voltage across the junction so that a current flows through the junction in response to a directed energy beam and is representative of a data state of a data storage cell diode.

22. A method of forming a diode structure for a phase-change data storage array, having multiple thin film layers adapted to form a plurality of data storage cell diodes, comprising:

depositing a first diode layer of CIS material on a substrate; and

depositing a second diode layer of phase-change material on the first diode layer.

23. The method of claim 22, wherein the phase-change material is InSe material.

24. The method of claim 22, wherein the steps of depositing the first diode layer and the second diode layer are done in the same vacuum system.25. The method of claim 22, wherein the steps of depositing the first diode layer and the second diode layer are done by electrodeposition.

26. The method of claim 22, wherein the steps of depositing the first diode layer and the second diode layer are done using an electrolyte.

27. The method of claim 22, further comprising depositing a field layer on the substrate prior to depositing the first diode layer.

28. The method of claim 22, wherein the field layer is deposited by sputtering.

29. The method of claim 22, wherein the steps of depositing the first diode layer and the second diode layer are done by performing elemental evaporation in vacuum.

30. The method of claim 22, wherein the steps of depositing the first diode layer and the second diode layer are done by sputtering.

31.. The method of claim 22, wherein the CIS material is p-doped.